License Plate Recognition with YOLO network

Guohua Zhu, Jaehan Joo, Donghwan Kim, Suk Chan Kim
Pusan National University

zhuguohua@pusan.ac.kr, jhjoo2018@pusan.ac.kr, black9591@pusan.ac.kr, sckim@pusan.ac.kr

Abstract

Abstract—This paper is based on the object detection network in deep learning and implements a real-time license plate detection method. This paper uses the YOLO object detection network and combines image data with license plate information to train the network. The network locates and recognizes license plate images. It can identify the license plate information of the vehicle according to the output of the network. The network can accurately identify the character information of the license plate, which can provide a reference for the development of intelligent transportation systems.

Keywords—object detection, YOLO, license plate detection, deep learning

Ⅰ. Introduction

Intelligent Transportation System(ITS) plays an important role in stolen vehicle tracking, traffic monitoring, speed limit enforcement, automatic parking, etc. [1], [2]. The main problems of license plate recognition technology include license plate positioning and character recognition.

For license plate positioning, currently commonly used technologies are divided into two categories: the first one is based on feature extraction methods, and it can be divided into methods based on grayscale features and methods based on color features. The second one is based on machine learning methods. It can also be divided into methods based on pattern recognition and methods based on deep learning. The method based on color features [3] cannot correctly locate the license plate image affected by lighting [4], low resolution, and unclear. In this case, the method based on color features will have the problem of incorrectly locating the license plate. The grayscale features of the license plate area contain enough information that can be used for license plate positioning, but the license plates based on grayscale features The positioning method requires a lot of calculation time. The license plate positioning method based on pattern recognition [5] is trained on the training set, and then the pictures of other license plates are detected. Türkyılmaz et al. used the neural network to classify the color of license plates [5]. For license plate positioning, this method is difficult to distinguish areas with similar license plates. In recent years, with the advent of the era of big data and the improvement of computer computing capabilities, deep learning has achieved great success in the target recognition, mainstream target recognition Framework includes Faster R-CNN [6], YOLO [7].

Ⅱ. Technical Approach

A. Data collection

We collect 4057 images. Of these images, 3586 images are training data, and 398 images are validation data, and the remaining 73 images are test data.

B. YOLO network architecture details

The YOLO network thoroughly implements the idea of using direct regression to obtain the current objects and object categories that need to be detected. It was first proposed by Redmon J and Farhadi A in 2015 [7]. In 2017 On CVPR, Redmon J and Farhadi A have successively proposed YOLOv2[8], YOLOv3[9].

The YOLO network first divides the input picture into S×S grids. If the center point of an object in the image falls within a certain grid, the grid is responsible for predicting the category of the object, as shown in Figure 2. Each grid will predict B bounding boxes and their confidence scores, and C category probabilities. Four values are x, y, w, and h which are used to represent the position of the detection frame. The YOLO object detection network uses a one-stage strategy. Compared with the traditional two-stage neural network object detection network, YOLO does not need to do the candidate box extraction step and directly return to the object

position and category. It greatly reduces the detection time and can achieve real-time parking space detection sexual requirements.

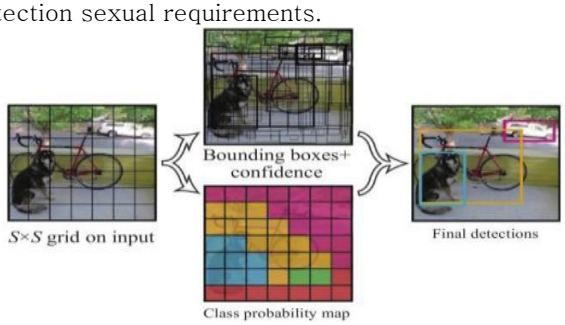

Figure 1. YOLO Network

Ⅲ. Results and Conclusion

We trained 200 epochs. The loss value is 25.12. The loss curve is shown in Figure 3 and the final test result is shown in Figure 4.

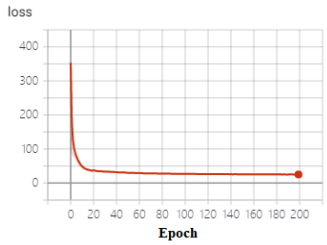

Figure 2. Loss curve

Accuracy is the simplest and effective method to evaluate the result. The accuracy of the results has reached 93.5%. There are 511 characters in the test set. 478 characters are detected correctly, and 25 out of the 33 wrong ones are Chinese characters.

In this paper, we show that the YOLO network can obtain effective results for the challenging task of large crowded character recognition. However, the recognition process of complex Chinese characters needs to be improved. In the future, this technology can be applied to smart transportation.

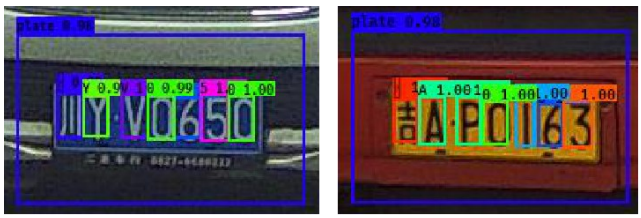

Figure 3. Results display

ACKNOWLEDGMENT

This work is financially supported by Korea Ministry of Land, Infrastructure and Transportation(MOLIT) as 「Innovative Talent Education Program for Smart City」.

This work was supported by the Human Resources Development program (No. 20204030200030) of the Korea Institute of Energy Technology Evaluation and Planning (KETEP) grant funded by the Korea government Ministry of Trade, Industry and Energy.

REFERENCES

[1] Gou C, Wang K F, Yao Y J, et al. Vehicle license plate recognition based on extremal regions and restricted boltzmann machines[J]. IEEE Transactions on Intelligent Transportation Systems, 2016, 17(4): 1096-1107.

[2] Min W D, Fan M D, Guo X G, et al. A new approach to track multiple vehicles with the combination of robust detection and two classifiers[J]. IEEE Transactions on Intelligent Transportation Systems, 2018, 19(1): 174-186.

[3] Abolghasemi V, Ahmadyfard A. An edge-based color-aided method for license plate detection[J]. Image and Vision Computing, 2009, 27(8): 1134-1142.

[4] Zhao Wei, Ju Meiyu, Li Zishuang. A license plate image enhancement algorithm under complicated illumination[J]. Journal of Computer-Aided Design & Computer Graphics, 2016, 28(6): 976-985.

[5] Türkyılmaz İ, Kaçan K. License plate recognition system using artificial neural networks[J]. ETRI Journal, 2016, 39(2): 163-172.

[6] Ren S Q, He K M, Girshick R, et al. Faster R-CNN: towards real-time object detection with region proposal networks[J]. IEEE Transactions on Pattern Analysis and Machine Intelligence, 2017, 39(6): 1137-1149.

[7] Redmon J, Divvala S, Girshick R, et al. You only look once: unified, real-time object detection[C] //Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. Los Alamitos: IEEE Computer Society Press, 2016: 779-788.

[8] Redmon J, Farhadi A. YOLO9000: Better, faster, stronger. Proceedings of 2017 IEEE Conference on Computer Vision and Pattern Recognition. Honolulu, HI, USA. 2017. 6517-6525.

[9] Redmon J, Farhadi A. YOLOv3: An incremental improvement. arXiv: 1804.02767, 2018.